

ATTACHMENT B
Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application.

1. (Withdrawn) A material for a solid polyelectrolyte; said material comprising:

a multi-segmented fluoropolymer having a fluoropolymer chain segment A containing sulfonic acid functional groups, which is a copolymer comprising:

- (a) an ethylenic fluoromonomer unit containing sulfonic acid functional groups represented by Formula (1)



wherein X and X¹ may be the same or different and are each hydrogen or fluorine; Y is F, Cl or OY¹ wherein Y¹ is hydrogen, alkali metal or C₁ to C₅ alkyl; Rf is C₁ to C₄₀ divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s); and n is 0 or 1; and

- (b) at least one type of ethylenic fluoromonomer unit copolymerizable with the unit (a) and containing no sulfonic acid functional groups;

and a fluoropolymer chain segment B containing no sulfonic acid functional groups, the fluoropolymer chain segment B having a crystalline melting point of 100°C or higher or a glass transition point of 100°C or higher.

2-4. (Canceled)

5. (Withdrawn) The material according to claim 1, wherein the at least one type of ethylenic fluoromonomer unit (b) containing no sulfonic acid functional groups comprises tetrafluoroethylene.

6. (Withdrawn) The material according to claim 1, wherein the fluoropolymer chain segment B is a polymer chain comprising 85 to 100 mol% of tetrafluoroethylene and 15 to 0 mol% of a monomer represented by Formula (3)



wherein Rf^a is CF_3 or ORf^b and Rf^b is C_1 to C_5 perfluoroalkyl.

7. (Withdrawn) The material according to claim 1, wherein the multi-segmented fluoropolymer has an equivalent weight of 400 to 1600.

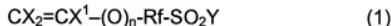
8. (Withdrawn) The material according to Claim 1, comprising a multi-segmented fluoropolymer having at least two types of fluoropolymer chain segments C and D containing sulfonic acid functional groups, the fluoropolymer chain segment C having a smaller equivalent weight than the fluoropolymer chain segment D.

9. (Withdrawn) The material according to Claim 8, wherein the fluoropolymer chain segment D has a crystalline melting point of 100°C or higher or a glass transition point of 100°C or higher.

10. (Withdrawn) The material according to Claim 8, wherein the fluoropolymer chain segments C and D containing sulfonic acid functional groups are each a copolymer comprising:

- (c) an ethylenic fluoromonomer unit containing sulfonic acid function groups; and
- (d) at least one type of ethylenic fluoromonomer unit copolymerizable with the unit (c) and containing no sulfonic acid functional groups.

11. (Withdrawn) The material according to claim 10, wherein the ethylenic fluoromonomer unit (c) containing sulfonic acid functional groups is represented by Formula (1)



wherein X and X¹ may be the same or different and are each hydrogen or fluorine; Y is F, Cl or OY¹ wherein Y¹ is hydrogen, alkali metal or C₁ to C₅ alkyl; Rf is C₁ to C₄₀ divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s); and n is 0 or 1.

12. (Withdrawn) The material according to Claim 8, comprising the multi-segmented fluoropolymer in which the fluoropolymer chain segment D has an equivalent weight of 1000 or more.

13. (Withdrawn) The material according to Claim 8, wherein the multi-segmented fluoropolymer has an equivalent weight of 400 to 1600.

14. (Withdrawn) A solid polyelectrolyte membrane comprising the multi-segmented fluoropolymer according to claim 1.

15. (Withdrawn) The solid polyelectrolyte membrane according to Claim 14, wherein the multi-segmented fluoropolymer contains protonated sulfonic acid (SO_3H) groups as the sulfonic acid functional groups, and has a modulus of elasticity of at least 1×10^8 dyn/cm² at 110°C or higher.

16. (Withdrawn) The solid polyelectrolyte membrane according to Claim 15, wherein the equivalent weight of the whole multi-segmented fluoropolymer is 1600 or less.

17. (Withdrawn) A multi-segmented fluoropolymer having a fluoropolymer chain segment A¹ containing sulfonic acid functional groups and a fluoropolymer chain segment B¹ containing no sulfonic acid functional groups, wherein:

the fluoropolymer chain segment A¹ containing sulfonic acid functional groups is a copolymer having a molecular weight of 5000 to 750000 and comprising:

- (e) 1 to 50 mol% of at least one type of structural unit represented by

Formula (1)



wherein X and X¹ may be the same or different and are each hydrogen or fluorine; Y is F, Cl and OY¹ wherein Y¹ is hydrogen, alkali metal or C₁ to C₅ alkyl; Rf is C₁ to C₄₀ divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s); and n is 0 or 1, and

- (f) 99 to 50 mol% of at least one type of ethylenic monomer structural unit containing no sulfonic acid functional groups; and

the fluoropolymer chain segment B¹ is a fluoropolymer chain containing at least one type of ethylenic fluoromonomer unit and having a molecular weight of 3000 to 12000000.

18. (Withdrawn) The multi-segmented fluoropolymer according to claim 17, wherein the ethylenic fluoromonomer (e) in the fluoropolymer chain segment A¹ is represented by Formula (2)



wherein Y is F, Cl or OY¹ wherein Y¹ is hydrogen, alkali metal or C₁ to C₅ alkyl; Rf is C₁ to C₄₀ divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s).

19. (Withdrawn) The multi-segmented fluoropolymer according to Claim 17, wherein the ethylenic monomer (f) in the fluoropolymer chain segment A¹ contains at least one ethylenic fluoromonomer.

20. (Withdrawn) The multi-segmented fluoropolymer according to Claim 19, wherein the ethylenic monomer (f) is tetrafluoroethylene.

21. (Withdrawn) The multi-segmented fluoropolymer according to Claim 17, wherein the fluoropolymer chain segment B¹ is a polymer chain comprising 85 to 100 mol% of tetrafluoroethylene and 15 to 0 mol% of a monomer represented by Formula (3)

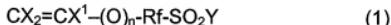


wherein Rf^a is CF₃ or ORf^b and Rf^b is C₁ to C₅ perfluoroalkyl.

22. (Withdrawn) A multi-segmented fluoropolymer having at least two types of fluoropolymer chain segments C¹ and D¹ containing sulfonic acid functional groups, wherein:

the fluoropolymer chain segment C¹ is a copolymer having a molecular weight of 5000 to 750000 and comprising:

(g) 13 to 50 mol% of at least one type of ethylenic fluoromonomer structural unit containing sulfonic acid functional groups and represented in Formula (1)



wherein X and X¹ may be the same or different and are each hydrogen or fluorine; Y is F, Cl or OY¹ wherein Y¹ is hydrogen, alkali metal or C₁ to C₅ alkyl; Rf is C₁ to C₄₀ divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s); and n is 0 or 1, and

(h) 87 to 50 mol% of at least one type of ethylenic monomer structural unit containing no sulfonic acid functional groups; and
the fluoropolymer chain segment D¹ is a fluoropolymer chain having a molecular weight of 3000 to 1200000 and comprising:

(i) not less than 0.1 mol% but less than 13 mol% of at least one type of ethylenic fluoromonomer unit containing sulfonic acid functional groups and represented by Formula (1)



wherein X, X¹, Y, n and Rf are as defined above, and

(j) more than 87 mol% but not more than 99.9 mol% of at least one type of ethylenic monomer unit containing no sulfonic acid functional groups.

23. (Withdrawn) The multi-segmented fluoropolymer according to claim 22, wherein the ethylenic fluoromonomer (g) in the fluoropolymer chain segment C¹ is represented by Formula (2)



wherein Y is F, Cl or OY¹ wherein Y¹ is hydrogen, alkali metal or C₁ to C₅ alkyl; Rf is C₁ to C₄₀ divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s).

24. (Withdrawn) The multi-segmented fluoropolymer according to Claim 22, wherein the ethylenic monomer (h) in the fluoropolymer chain segment C¹ contains at least one ethylenic fluoromonomer.

25. (Withdrawn) The multi-segmented fluoropolymer according to Claim 24, wherein the ethylenic monomer (h) in the fluoropolymer chain segment C¹ is tetrafluoroethylene.

26. (Withdrawn) The multi-segmented fluoropolymer according to claim 22, wherein the ethylenic fluoromonomer (i) in the fluoropolymer chain segment D¹ is represented by Formula (2)



wherein Y is F, Cl or OY¹ wherein Y¹ is hydrogen, alkali metal or C₁ to C₅ alkyl; Rf is C₁ to C₄₀ divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s).

27. (Withdrawn) The multi-segmented fluoropolymer according to Claim 22, wherein the ethylenic monomer (j) in the fluoropolymer chain segment D¹ contains at least one ethylenic fluoromonomer.

28. (Withdrawn) The multi-segmented fluoropolymer according to Claim 27, wherein the ethylenic monomer (j) in the fluoropolymer chain segment D¹ is tetrafluoroethylene.

29. (Withdrawn) A solid polyelectrolyte membrane comprising the multi-segmented fluoropolymer according to claim 8.

30. (Currently Amended) A material for a solid polyelectrolyte, comprising a multi-segmented fluoropolymer that comprises a block copolymer and/or a graft copolymer,

wherein the copolymer contains one or more blocks essentially consisting of segment A and one or more blocks essentially consisting of segment B, the segment A combines with the segment B,

wherein the segment A is a copolymer chain comprising:

- (a) an ethylenic fluoromonomer containing sulfonic acid functional groups; and
- (b) at least one type of ethylenic fluoromonomer copolymerizable with the ethylenic fluoromonomer (a) and containing no sulfonic acid functional groups,

the segment B is a fluoropolymer containing no sulfonic acid functional groups, has a molecular weight of 1,000 3,000 to 1,200,000, and has a crystalline melting point of 100°C or higher or a glass transition point of 100°C or higher,

wherein the ratio of segment A : segment B in the segmented fluoropolymer is 5:95 to 98:2 wt. %.

31-34. (Canceled)

35. (Previously Presented) The material according to claim 30, wherein the fluoropolymer segment B is a polymer comprising 85 to 100 mol% of tetrafluoroethylene and 15 to 0 mol% of a monomer represented by Formula (3)



wherein Rf^a is CF_3 or ORf^b wherein Rf^b is C_1 to C_5 perfluoroalkyl.

36. (Previously Presented) The material according to claim 30, wherein the multi-segmented fluoropolymer has an equivalent weight of 400 to 1600.

37. (Withdrawn) The material according to claim 8, which comprises a multi-segmented fluoropolymer having a block copolymer of at least two types of fluoropolymer chain segments C and D containing sulfonic acid functional groups, the fluoropolymer chain segment C having a smaller equivalent weight than the fluoropolymer chain segment D.

38. (Previously Presented) A solid polyelectrolyte membrane comprising the multi-segmented fluoropolymer according to claim 30.

39. (Previously Presented) The solid polyelectrolyte membrane according to claim 38, wherein the multi-segmented fluoropolymer contains protonated sulfonic acid (SO_3H) groups as the sulfonic acid functional groups, and has a modulus of elasticity of at least 1×10^8 dyn/cm² at 110°C or higher.

40. (Previously Presented) The solid polyelectrolyte membrane according to claim 39, wherein the equivalent weight of the whole multi-segmented fluoropolymer is 1600 or less.

41. (Withdrawn) The multi-segmented fluoropolymer according to claim 17, which has a block copolymer of a fluoropolymer chain segment A¹ containing sulfonic acid functional groups and a fluoropolymer chain segment B¹ containing no sulfonic acid functional groups, wherein:

the fluoropolymer chain segment A¹ containing sulfonic acid functional groups is a copolymer having a molecular weight of 5000 to 750000 and comprising:

(e) 1 to 50 mol% of at least one type of structural unit represented by Formula (1)



wherein X and X¹ may be the same or different and are each hydrogen or fluorine; Y is F, Cl or OY¹ wherein Y¹ is hydrogen, alkali metal or C₁ to C₅ alkyl; Rf is C₁ to C₄₀ divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s); and n is 0 or 1, and,

(f) 99 to 50 mol% of at least one type of ethylenic monomer structural unit containing no sulfonic acid functional groups; and

the fluoropolymer chain segment B¹ is a fluoropolymer chain containing at least one type of ethylenic fluoromonomer unit and having a molecular weight of 3000 to 1200000.

42. (Withdrawn) The multi-segmented fluoropolymer according to claim 22, which has a block copolymer of at least two types of fluoropolymer chain segments C¹ and D¹ containing sulfonic acid functional groups, wherein:

the fluoropolymer chain segment C¹ is a copolymer having a molecular weight of 5000 to 750000 and comprising:

(g) 13 to 50 mol% of at least one type of ethylenic fluoromonomer structural unit containing sulfonic acid functional groups and represented by Formula (1)



wherein X and X¹ may be the same or different and are each hydrogen or fluorine; Y is F, Cl or OY¹ wherein Y¹ is hydrogen, alkali metal or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s); and n is 0 or 1, and

(h) 87 to 50 mol% of at least one type of ethylenic monomer structural unit containing no sulfonic acid functional groups; and

the fluoropolymer chain segment D¹ is a fluoropolymer chain having a molecular weight of 3000 to 1200000 and comprising:

(i) not less than 0.1 mol% but less than 13 mol% of at least one type of ethylenic fluoromonomer unit containing sulfonic acid functional groups and represented by Formula (a)



wherein X, X¹, Y, n and Rf are as defined above, and

(j) more than 87 mol% but not more than 99.9 mol% of at least one type of ethylenic monomer unit containing no sulfonic acid functional groups.

43. (Withdrawn) The solid polyelectrolyte membrane according to claim 29, wherein the multi-segments fluoropolymer contains protonated sulfonic acid (SO_3H) groups as the sulfonic acid functional groups, and has a modulus of elasticity of at least 1×10^8 dyn/cm² at 110°C or higher.

44. (Withdrawn) The solid polyelectrolyte membrane according to claim 43, wherein the equivalent weight of the whole multi-segmented fluoropolymer is 1600 or less.

45. (Canceled)

46. (Previously Presented) The material according to claim 30, wherein the molecular weight of the segment A is 5,000 to 1,000,000.

47-48. (Canceled)

49. (Previously Presented) The material according to claim 30, wherein the ethylenic fluoromonomer (a) containing sulfonic acid functional groups is represented by Formula (1)



wherein X and X¹ may be the same or different and are each hydrogen or fluorine; Y is F, Cl or OY¹ wherein Y¹ is hydrogen, alkali metal or C₁ to C₅ alkyl; Rf is C₁ to C₄₀

divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s); and n is 0 or 1.

50. (Previously Presented) The material according to claim 46, wherein the ethylenic fluoromonomer (a) containing sulfonic acid functional groups is represented by Formula (1)



wherein X and X¹ may be the same or different and are each hydrogen or fluorine; Y is F, Cl or OY¹ wherein Y¹ is hydrogen, alkali metal or C₁ to C₅ alkyl; Rf is C₁ to C₄₀ divalent fluoroalkylene or C₁ to C₄₀ divalent fluoroalkylene having ether bond(s); and n is 0 or 1.

51. (Previously Presented) The material according to claim 30, wherein the at least one type of ethylenic fluoromonomer (b) containing no sulfonic acid functional groups is tetrafluoroethylene.

52. (Previously Presented) The material according to claim 46, wherein the at least one type of ethylenic fluoromonomer (b) containing no sulfonic acid functional groups is tetrafluoroethylene.